Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria® myelopathy.

BIBLIOGRAPHIC SOURCE(S)

Seidenwurm DJ, Wippold FJ II, Brunberg JA, Cornelius RS, Davis PC, De La Paz RL, Dormont PD, Gray L, Jordan JE, Mukherji SK, Turski PA, Zimmerman RD, Sloan MA, Expert Panel on Neurologic Imaging. ACR Appropriateness Criteria® myelopathy. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 11 p. [61 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Seidenwurm DJ, Brunberg JA, Davis PC, De La Paz RL, Dormont PD, Hackney DB, Jordan JE, Karis JP, Mukherji SK, Turski PA, Wippold FJ II, Zimmerman RD, McDermott MW, Sloan MA, Expert Panel on Neurologic Imaging. Myelopathy. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 11 p. [58 references]

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Myelopathy

GUIDELINE CATEGORY

Diagnosis
Evaluation

CLINICAL SPECIALTY

Emergency Medicine
Infectious Diseases
Neurological Surgery
Neurology
Nuclear Medicine
Oncology
Radiology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for patients with myelopathy

TARGET POPULATION

Patients with myelopathy

INTERVENTIONS AND PRACTICES CONSIDERED

1. Computed tomography (CT), spine
    - Without contrast
    - With contrast
2. Computed tomography angiography (CTA), spine
3. Magnetic resonance imaging (MRI), spine
    - Without contrast
    - Without and with contrast
4. Magnetic resonance angiography (MRA), spine, with or without contrast
5. Myelography and postmyelography CT, spine
6. X-ray
    - Spine
    - Myelography
    - Discography
7. Nuclear medicine (NUC)
    - Technetium (Tc)-99m bone scan with single-photon emission computed tomography (SPECT), spine
    - Indium (In)-111 white blood cell (WBC) scan, spine

8. Invasive (INV)
    - Spinal arteriography
    - Epidural venography
9. Ultrasound (US), spine

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of peer-reviewed medical journals, and the major applicable articles were identified and collected.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Myelopathy

Variant 1: Traumatic.

Radiologic Procedure	Rating	Comments	RRL*
CT spine without contrast	9	First test for acute management.	Med
MRI spine without contrast	8	Problem solving or operative planning. Most useful when injury not explained by bony fracture.	None
X-ray spine	7	May be first test in multisystem trauma, especially when CT is delayed. To assess stability.	Med
Myelography and postmyelography CT spine	5	MRI preferable.	High
X-ray myelography	3	Usually performed in conjunction with CT.	Med
MRA spine with or without contrast	3	For suspected vascular trauma. Use of contrast may vary depending on technique used.	None
CTA spine	3	For suspected vascular trauma.	Med
INV arteriography spine	2		IP
MRI spine without and with contrast	2		None
CT spine with contrast	2		Med
NUC Tc-99m bone scan with SPECT spine	2		Med
NUC In-111 WBC scan spine	2		Med
INV epidural venography	1		IP
US spine	1		None
X-ray discography	1		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative**

Radiologic Procedure	Rating	Comments	RRL*
			Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Painful.

Radiologic Procedure	Rating	Comments	RRL*
MRI spine without contrast	8		None
MRI spine without and with contrast	7	If infection or neoplastic disorder suspected. See comments regarding contrast in the text below under "Anticipated Exceptions."	None
CT spine without contrast	7	Most useful for spondylosis.	Med
Myelography and postmyelography CT spine	5	Problem solving or if MRI unavailable or contraindicated.	High
NUC Tc-99m bone scan with SPECT spine	4	Search for associated extraspinal disease.	Med
X-ray spine	3	To assess stability.	Med
CT spine with contrast	3	Consider for infection, neoplasm or if MRI unavailable or contraindicated.	Med
X-ray myelography	2	Usually performed in conjunction with CT.	Med
MRI spine flow	2		None
INV arteriography spine	2		IP
NUC In-111 WBC scan spine	2		Med
CTA spine	2	Problem solving.	Med
US spine	1		None

Radiologic Procedure	Rating	Comments	RRL*
X-ray discography	1		Med
INV epidural venography	1		IP
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Sudden onset.

Radiologic Procedure	Rating	Comments	RRL*
MRI spine without contrast	9		None
MRI spine without and with contrast	8	See comments regarding contrast in the text below under "Anticipated Exceptions."	None
Myelography and postmyelography CT spine	6	Problem solving or if MRI unavailable or contraindicated.	High
X-ray myelography	6	Usually performed in conjunction with CT.	Med
CT spine without contrast	5	Problem solving or if MRI unavailable or contraindicated.	Med
CTA spine	5	If AVM is suspected.	Med
INV arteriography spine	4	If AVM is suspected.	IP
MRA spine with or without contrast	4	If AVM is suspected. Use of contrast may vary depending on technique used. See comments regarding contrast in the text below under "Anticipated Exceptions."	None
X-ray spine	3	To assess stability.	Med
CT spine with contrast	3		Med

Radiologic Procedure	Rating	Comments	RRL*
NUC Tc-99m bone scan with SPECT spine	2		Med
NUC In-111 WBC scan spine	2		Med
X-ray discography	1		Med
US spine	2		None
INV epidural venography	1		IP
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: Stepwise progressive.

Radiologic Procedure	Rating	Comments	RRL*
MRI spine without contrast	9		None
MRI spine without and with contrast	8	See comments regarding contrast in the text below under "Anticipated Exceptions."	None
INV arteriography spine	6	If AVM is suspected.	IP
X-ray myelography	6	Usually performed in conjunction with CT. If AVM is suspected.	Med
Myelography and postmyelography CT spine	6	Problem solving or if MRI unavailable or contraindicated.	High
CT spine without contrast	5	Problem solving or if MRI unavailable or contraindicated.	Med
CTA spine	5		Med
MRA spine with or without contrast	4	Use of contrast may vary depending on technique used. See comments	None

Radiologic Procedure	Rating	Comments	RRL*
		regarding contrast in the text below under "Anticipated Exceptions."	
CT spine with contrast	3		Med
X-ray spine	3		Med
NUC Tc-99m bone scan with SPECT spine	2		Med
NUC In-111 WBC scan spine	2		Med
X-ray discography	1		Med
US spine	1		None
INV epidural venography	1		IP
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 5: Slowly progressive.

Radiologic Procedure	Rating	Comments	RRL*
MRI spine without contrast	8		None
MRI spine without and with contrast	7	See comments regarding contrast in the text below under "Anticipated Exceptions."	None
CT spine without contrast	6	Most useful for spondylosis.	Med
Myelography and postmyelography CT spine	5	Problem solving or if MRI unavailable or contraindicated.	High
X-ray myelography	5	If MRI is not possible or for preoperative planning and problem	Med

Radiologic Procedure	Rating	Comments	RRL*
		solving Usually performed in conjunction with CT.	
INV arteriography spine	4		IP
NUC Tc-99m bone scan with SPECT spine	4		Med
X-ray spine	3	To assess stability.	Med
CT spine with contrast	3	Infection or neoplasms suspected, or if MRI unavailable or contraindicated.	Med
NUC In-111 WBC scan spine	2		Med
MRA spine with or without contrast	2	Use of contrast may vary depending on technique used.	None
CTA spine	2		Med
US spine	1		None
INV epidural venography	1		IP
X-ray discography	1		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 6: Infectious disease patient.

Radiologic Procedure	Rating	Comments	RRL*
MRI spine without and with contrast	9	See comments regarding contrast in the text below under "Anticipated Exceptions."	None
MRI spine without contrast	8		None
CT spine without	6	If MRI unavailable or contraindicated.	Med

Radiologic Procedure	Rating	Comments	RRL*
contrast			
X-ray myelography	5	If MRI not feasible. Usually performed in conjunction with CT.	Med
CT spine with contrast	5		Med
Myelography and postmyelography CT spine	5	Problem solving or if MRI unavailable or contraindicated.	High
NUC In-111 WBC scan spine	4	May be combined with bone scan to diagnose osteomyelitis.	Med
X-ray spine	3	To assess stability.	Med
MRA spine with or without contrast	2	Use of contrast may vary depending on technique used.	None
INV arteriography spine	2		IP
CTA spine	2		Med
X-ray discography	1		Med
INV epidural venography	1		IP
US spine	1		None
NUC Tc-99m bone scan with SPECT spine	1	Indicated if multifocal disease is suspected	Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 7: Oncology patient.

Radiologic Procedure	Rating	Comments	RRL*
MRI spine without contrast	9		None

Radiologic Procedure	Rating	Comments	RRL*
MRI spine without and with contrast	8	See comments regarding contrast in the text below under "Anticipated Exceptions."	None
CT spine without contrast	6	Problem solving or if MRI unavailable or contraindicated.	Med
NUC Tc-99m bone scan with SPECT spine	6	Search for extraspinal disease.	Med
Myelography and postmyelography CT spine	5	If MRI is not feasible.	High
X-ray myelography	5	If MRI is not feasible. Usually performed in conjunction with CT.	Med
CT spine with contrast	4		Med
X-ray spine	3	Assess stability or for treatment planning.	Med
INV arteriography spine	2		IP
MRA spine with or without contrast	2	Use of contrast may vary depending on technique used.	None
NUC In-111 WBC scan spine	2		Med
CTA spine	2	Treatment planning or problem solving.	Med
INV epidural venography	1		IP
US spine	1		None
X-ray discography	1		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

The term myelopathy is used to describe any neurological deficit related to the spinal cord itself. Most frequently, myelopathy is due to compression of the spinal cord by osteophyte or extruded disc material in the cervical spine. Osteophytic spurring and disc herniation may also produce myelopathy localized to the thoracic spine, though this is less common. The next most common sources of myelopathy are spinal cord compression due to extradural mass caused by carcinoma metastatic to bone, and blunt or penetrating trauma. Many primary neoplastic, infectious, inflammatory, neurodegenerative, vascular, nutritional, and idiopathic disorders may also result in myelopathy, though these are very much less common than discogenic disease, metastases, and trauma. A variety of cysts and benign neoplasms may also compress the cord; these tend to arise intradurally. The most common of these are meningiomas, nerve sheath tumors, epidermoid cysts, and arachnoid cysts.

In general, disorders of the spinal cord itself are uncommon and difficult to treat effectively. Therefore, most attention in the radiological evaluation of myelopathy is focused on extrinsic compression of the spinal cord. Classically, radiological evaluation of myelopathic patients consisted of positive contrast myelography. Later, this evaluation was supplemented by computed tomography (CT) and CT myelography, and then magnetic resonance imaging (MRI) became the mainstay in the evaluation of myelopathy. More recently, imaging of the spinal cord has improved to the point that reliable diagnosis of nonexpansile spinal cord lesions is routinely possible.

Despite the wide variety of causes of myelopathy, diagnosis and treatment rest on demonstration of mechanical stability of the spine, particularly in the cervical region and when tumor or trauma history is present. Depiction of direct neural involvement by a pathologic process is then required for more refined diagnosis and specific treatment decisions. Anatomical diagnosis of myelopathy rests principally in the distinction between extradural, intradural, and intramedullary lesions.

Clinically, the diagnosis of myelopathy depends on the neurological localization of the finding to the spinal cord, rather than the brain or peripheral nervous system, and then to a particular segment of the spinal cord. The antecedent clinical syndrome and other details of the patient's course help to refine diagnosis, but imaging plays a crucial role. In general, myelopathy is clinically divided into categories based on the presence or absence of significant trauma, the presence or absence of pain, and the mode of onset (slowly progressive or insidious onset vs. a stepwise progression vs. a sudden onset). Patients with known tumor history and those in whom infectious disease is likely may also be considered separately.

In the patient with traumatic myelopathy, the first priority for the spine is assessing its mechanical stability. Plain radiographs are useful for this purpose, but CT may be more useful when a high probability of bony injury or ligamentous injury is present. At some centers, routine multidetector CT with sagittal and coronal reconstructions is supplanting the role of plain radiographs, especially in the setting of multiple trauma.

MRI is widely considered the study of choice when paralysis is incomplete or under other circumstances where direct visualization of neural or ligamentous structures is clinically necessary. If surgery for herniated disc, hematoma, or

other cause of incomplete paralysis is planned, MRI best depicts the relation of pathology to the cord, and can help predict which patients may benefit from surgery.

When local or radicular pain accompanies myelopathy, the most likely diagnoses are spondylosis, tumor, or infection. Plain radiographs may depict osteophytic narrowing of the spinal canal or bone destruction. CT improves the depiction of both bony encroachment on the spinal canal and compression of neural structures by herniated disc material that is occult to plain radiographic evaluation. Bone destruction and soft-tissue masses are also better seen. MRI has largely replaced CT scanning in the noninvasive evaluation of patients with painful myelopathy because of its superior soft-tissue resolution and multiplanar capability. Invasive evaluation by means of myelography and CT myelography may be supplemental when visualization of neural structures is required for surgical planning or other specific problem solving, though this is less frequent.

Although painful myelopathy is most commonly due to spondylosis and disc herniation, a significant proportion is caused by tumor or infection. Demyelinating disease may present with pain symptoms as well. Occasionally, syringomyelia may present with the anesthetica dolorosa syndrome. The ability of MRI to depict the spinal cord directly, and to assess its contour and internal signal characteristics reliably and noninvasively, has resulted in general acceptance of MRI as the study of choice in evaluating cervical myelopathy when spondylosis or disc herniation is the most likely cause. When MRI is not available, or to answer specific questions before surgical intervention, myelography and CT myelography may be useful.

In slowly progressive myelopathy, the ability of MRI to depict the spinal cord noninvasively is most valuable. Some specifically treatable disorders may be localized and depicted quite well by means of myelography followed by CT myelography. However, the occasional complication of myelography in cases of spinal block, difficulty in visualizing the upper extent of lesions, and relative "blind spots" at the cervical thoracic and craniocervical junctions limit the utility of myelography. CT myelographic techniques may help avoid these pitfalls and may be useful to answer specific preoperative questions about bony anatomy.

Enlargement of the spinal cord by intramedullary mass is well depicted by myelography only when large masses are present. CT myelography can be extremely useful in supplementing the plain radiographic examination. These techniques, however, are less useful than MRI because the distinction between solid and cystic masses is usually not possible, even when delayed examination is performed. The distinction of syrinx from tumor, location of tumor nodule, extent of cyst, and distinction of nodule and cyst from edema are crucial in treatment planning for intramedullary disease and virtually necessitate MRI.

When myelopathy progresses stepwise or is of sudden onset, vascular processes become significant diagnostic possibilities. Vascular malformations, spinal cord infarct, and epidural hematoma account for most of the vascular lesions of the cord. In practice, they are difficult to distinguish clinically from other nontraumatic causes of myelopathy because the classic history is frequently absent or difficult to elicit from a seriously ill patient.

If arteriovenous malformation (AVM) is considered clinically likely, gadolinium-enhanced MRI, MR angiography, and myelography to demonstrate abnormal vasculature may be useful adjuncts to guide spinal arteriography. More recently, progress in CT angiography has led to its use in preangiographic evaluation of patients with suspected spinal vascular abnormalities.

If myelopathy is painless and slowly progressive, the differential diagnosis is quite broad. Neoplastic disease of the spinal cord and extrinsic compression by epidural or intradural tumor may present in this manner. Demyelinating disease, degenerative diseases, and metabolic or deficiency diseases may also present in this fashion. Spondylosis may present painlessly as well, particularly in the elderly. In these cases, visualization of the spine as well as the spinal cord is useful, and this is best accomplished noninvasively by MRI.

In oncology and infectious disease patients, multiple sites of involvement are possible. In these patients it is often necessary to study the entire spine or even the entire skeleton despite a specifically localized myelopathic level. MRI is considered more sensitive at an individual site, but the convenience of radionuclide bone scanning makes it useful in this setting as well. Acquired immune deficiency syndrome (AIDS) patients may present with myelopathy due to primary cord disease caused by human immunodeficiency virus (HIV) infection. No high-quality evidence supports the use of discography, thermography, epidural venography, ultrasound, or central spinal fluid (CSF) flow studies in the evaluation of myelopathy. Radionuclide bone scan may play an adjunctive role, for example, to locate a safer biopsy site in patients with suspected metastatic cord compression.

An important limitation of MRI in the diagnosis of myelopathy is its high sensitivity. The ease with which the study depicts expansion and compression of the spinal cord in the myelopathic patient may lead to false positive examinations and inappropriately aggressive therapy if findings are interpreted incorrectly. For example, transverse myelitis due to demyelinating disease may demonstrate cord enlargement and be mistaken for tumor. Spondylosis, which occurs with normal aging, may be mistaken for clinically significant osteophytic compression of the spinal cord in a patient who is myelopathic for other reasons. These problems are minimized by experienced observers and meticulous clinical correlation with radiologic findings. Similar problems are present in the interpretation of any anatomical study of the spinal cord and are not unique to MRI. Careful patient selection and clinical correlation are essential in interpretation of imaging findings everywhere.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF, also known as nephrogenic fibrosing dermopathy) was first identified in 1997 and has recently generated substantial concern among radiologists, referring doctors and lay people. Until the last few years, gadolinium-based MR contrast agents were widely believed to be almost universally well tolerated, extremely safe and non-nephrotoxic, even when used in patients with impaired renal function. All available experience suggests that these agents remain generally very safe, but recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed NSF, a syndrome that can be fatal. Further studies are necessary

to determine what the exact relationships are between gadolinium-containing contrast agents, their specific components and stoichiometry, patient renal function and NSF. Current theory links the development of NSF to the administration of relatively high doses (e.g., >0.2mM/kg) and to agents in which the gadolinium is least strongly chelated. The U.S. Food and Drug Administration (FDA) has recently issued a "black box" warning concerning these contrast agents (http://www.fda.gov/cder/drug/InfoSheets/HCP/gcca_200705HCP.pdf).

This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated glomerular filtration rate [GFR] <30 mL/min/1.73m^2), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

Abbreviations

- AVM, arteriovenous malformation
- CT, computed tomography
- CTA, computed tomography angiography
- In, indium
- INV, invasive
- IP, in progress
- Med, medium
- MRA, magnetic resonance angiography
- MRI, magnetic resonance imaging
- NUC, nuclear medicine
- SPECT, single photon emission computed tomography
- Tc, technetium
- US, ultrasound
- WBC, white blood cell

Relative Radiation Level	Effective Dose Estimated Range
None	0
Minimal	<0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv
*RRL assignments are not included for some examinations. The RRL assignments for the IP (in progress) exams will be available in future releases.	

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Selection of appropriate radiologic imaging procedures for evaluation of patients with myelopathy

POTENTIAL HARMS

- An important limitation of magnetic resonance imaging (MRI) in the diagnosis of myelopathy is its high sensitivity. The ease with which the study depicts expansion and compression of the spinal cord in the myelopathic patient may lead to false positive examinations and inappropriately aggressive therapy if findings are interpreted incorrectly.
- Similar problems are present in the interpretation of any anatomical study of the spinal cord and are not unique to MRI. Careful patient selection and clinical correlation are essential in interpretation of imaging findings everywhere.
- The occasional complication of myelography in cases of spinal block, difficulty in visualizing the upper extent of lesions, and relative "blind spots" at the cervical thoracic and craniocervical junctions limit the utility of myelography.
- Some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed nephrogenic systemic fibrosis (NSF), a syndrome that can be fatal. The U.S. Food and Drug Administration (FDA) has recently issued a "black box" warning concerning these contrast agents. This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated glomerular filtration rate [GFR] <30 mL/min/1.73m^2), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the American College

of Radiology (ACR) Appropriateness Criteria® Radiation Dose Assessment Introduction document (see "Availability of Companion Documents" field).

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Living with Illness

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Seidenwurm DJ, Wippold FJ II, Brunberg JA, Cornelius RS, Davis PC, De La Paz RL, Dormont PD, Gray L, Jordan JE, Mukherji SK, Turski PA, Zimmerman RD, Sloan MA, Expert Panel on Neurologic Imaging. ACR Appropriateness Criteria® myelopathy. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 11 p. [61 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1996 (revised 2008)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Neurologic Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: David J. Seidenwurm, MD; Franz J. Wippold II, MD; James A. Brunberg, MD; Rebecca S. Cornelius, MD; Patricia C. Davis, MD; Robert L. De La Paz, MD; Pr. Didier Dormont; Linda Gray, MD; John E. Jordan, MD; Suresh Kumar Mukherji, MD; Patrick A. Turski, MD; Robert D. Zimmerman, MD; Michael A. Sloan, MD, MS

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Seidenwurm DJ, Brunberg JA, Davis PC, De La Paz RL, Dormont PD, Hackney DB, Jordan JE, Karis JP, Mukherji SK,

Turski PA, Wippold FJ II, Zimmerman RD, McDermott MW, Sloan MA, Expert Panel on Neurologic Imaging. Myelopathy. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 11 p. [58 references]

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® *Anytime*, *Anywhere*™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria® radiation dose assessment introduction. American College of Radiology. 2 p. Electronic copies: Available from the American College of Radiology Web site.

PATIENT RESOURCES

None available

NGC STATUS

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